DOCUMENT RESUME

ED 399 148 SE 058 311

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TITLE A Study of the Images of the Scientist for Elementary School Children.
PUB DATE Apr 96
NOTE 12p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (St. Louis, MO, April 1, 1996).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Education; Foreign Countries; *Scientists; *Student Attitudes
IDENTIFIERS Taiwan

ABSTRACT

The purpose of this study was to explore elementary school children's images of scientists with emphasis on how children define scientists, their idea of the nature of scientists' work, and factors that might influence the formation of their images of scientists. Twenty-eight 5th and 6th grade students were asked to draw pictures and write compositions about scientists and were then interviewed for further details regarding their images of scientists. Results indicate that the students did not differentiate scientists from non-scientists very clearly and placed emphasis on scientists' contributions to the well-being of mankind. In addition, findings suggest that students view scientific research as the absolute truth and scientific experiments as proof or verification. Students' images of scientists were found to be influenced by the media, in particular by scientists' biographies. Contains 12 references. (JRH)

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ED 399 148

# A STUDY OF THE IMAGES OF THE SCIENTIST FOR ELEMENTARY SCHOOL CHILDREN

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A paper presented in the paper set grouped by committee session at the annual meeting of the National Association for Research in Science Teaching.

St. Louis, Missouri

April, 1996

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**Purpose**

The word "scientist", familiar to both adults and children, appears frequently in our everyday life. Although many students would say that they have never met any scientist in all their lives(Rampal, 1992), they are able to describe their own images of scientists' appearance, personalities, and works in many ways. However, what does it mean to be a scientist for the children? Hill & Wheeler(1991) reported that students conveyed very clear notions regarding what scientific employments are. In contrast, Rampal(1992) argued that there were a lot of people who presented unequivocal answers to some disciplines, such as astrology and the indigenous systems of medicine. This is especially worth noting in Taiwan. Because in addition to western science and technologies, traditional professional practices, for instance, acupuncture, herb medicine, and so on, with their long histories and being deeply rooted in the indigenous culture, still find their ways into the daily lives among all walks of life.

In addition, the science textbooks in Taiwan are mainly devoted to the teaching of science concepts and process skills, paying scarce attention to the history and the nature of science. Most of the students come across stories about scientists and inventors from studying the subject of Mandarin, as far as formal schooling is concerned. These stories in the textbooks tend to emphasize the positive characters of inventors and scientists, such as persistency and diligence, and encourage students to follow these examples. Some famous inventors and scientists are also mentioned in social study textbooks in Taiwan. The intention is, however, to show their achievement and contributions to mankind as a

whole. Becides these, many parents in Taiwan buy story books and scientists' biographies for their children to read. Most of these also tend to focus on the positive sides of inventors and scientists, aiming at encouraging children to model themselves on the inventors or scientists.

With the cultural background for pupils in Taiwan as mentioned above, it is worthwhile noting that results from numerous studies(Chambers, 1983; Kahle, 1989; Mead & Metraux, 1957) indicated that students held both positive and negative images of scientists regarding their appearance, works, personalities, and influence to human beings. Since these images of scientists form part of students' world view, it is expected that they will influence children's learning of science(Head, 1985). For these reasons, a study of the images of the scientists for elementary school children in Taiwan seems worthwhile. The focus of this study is to find out how children define scientists and non-scientists, what is their understanding of the nature of scientists' work, and what are the key factors which influence the formation of the image of scientists for elementary school children in Taiwan.

**Design and Procedures**

Three different methods--questionnaire using Likert or semantic differential scale, Draw-A-Scientist Test (DAST), Interview About Instance(IAI)--were jointly used in this study, in an attempt to strengthen the advantages of these methods while compensating their individual limitations. The entire study was carried out in two stages. The procedures in each stage are described as follows.

1. Exploratory Stage

With the DAST method, the twenty eight selected students from four classes of fifth and sixth grades were asked to draw pictures and to write compositions about scientists. Their drawings and writings were analyzed and classified according to certain schemes which were developed in this study to summarize important dimensions of students' images of scientists, such as appearance, personalities, types of work, and the nature of their work.

2. Interview

Seven sample students were selected from each class, according to their performance in the drawing and essay writing, and then interviewed for their further explanation about the definition and image of scientists, using both IAI and the semantic differential scale methods. For instance, in order to understand children's opinion of scientists' personality, we gave students a list of ten adjectives, including diligent, enthusiastic, amiable, etc. during the interview, and asked them to give the opposite of each adjective. The interviewer, i.e. the first author, drew a line between these two adjectives, and encouraged students to choose the most suitable place on the line to describe their opinions of scientists (see, for instance, Fig.1), and to offer an explanation as to why they chose to do so. Approximately thirty minutes were spent in interviewing each student, and the conversations during the interviews were recorded, transcribed, and analyzed later on.

diligent _____ lazy

Fig.1.

**Findings**

The drawings of the pupils in this study were quite similar to those in the western countries (i.e. Chambers, 1983; Kahle, 1989; Mason, Kahle, & Gardner, 1991; Schibeci & Sorensen, 1983). Most of the scientists drawn were old , male, crazy, and working with laboratory equipment; besides, they also wore glasses and white clothes. However, pupils in this study seldom described scientists' appearence in their compositions, they tended to focus on scientists' contributions to humanity. It is worth noting that pupils not only praised scientists'/ inventors' acheivement--especially their inventions, but also imagined or wished that they could invent something to make their or their parents' life more convenient and comfortable.

> "...They(scientists/inventors) make great contribution to mankind, for example, electric lamp, dynamite, and medicine. I wish I could invent a robot which can clean a house and wash a lot of dishes. Because my mother is very busy, I want to invent such a robot to help her and ease her of heavy housework." (S4504)

Acording to children's responses in the interview, important results of this study could be summarized as follows:

1. The boundary with which pupils differentiated scientists from nonscientists was vague.

Many students interviewed thought that they could differentiate scientists from nonscientists, and almost all of them argued that those who did research were scientists. However, when they were asked to judge

whether science teachers, doctors, astronomers, and inventors were scientists or not, it was found that they could not make a definite decision. Some of the pupils used 1/3 or 1/2 to describe the level with which science teachers, doctors or astronomers were considered as experts similar to scientists.

Some of the students argued that inventors, such as Tsai Luen whose story in inventing papers, is mentioned in social science textbooks and children's story books also studied very hard and benefited human beings, and therefore should be considered as scientists.

I: Do you think your science teacher is a scientist?

S: He is one third of a scientist.

I: Why?

S: One third, well, our teacher had studied science before, and he might be a scientist some day. But he ought to have done something that had a great INFLUENCE since he was young, then he could be called a scientist.

I: What kind of INFLUENCE should he have done when he was a child?

S: (He could) INVENT THINGS or...something that could bring benefit to mankind. (S1504-5)

I: What kind of people would you call a scientist?

S: Those who do research and invent things that benifit human beings.

I: Are invertors scientists?

S: Well...Yeah, they work very hard. They are diligent, and they always help us lead to more comfortable life. (S4606-1)

2. The values pupils placed on scientists were primarily for the well-being of mankind.

According to pupils' responses quoted, we note that pupils tended to think that scientists often worked for human benefits. Moreover, scientists were most willing to make their inventions available to people. The stories that pupils read often portrait such a picture for scientists/inventors. Most pupils tended to think that only a few "bad" scientists were so selfish that they invented something bad to other people or cooperate with outlaws.

I: What do the scientist do?

S: Well, he would contribute something to his country or society, and he would invent something convenient for all human beings. (S1604-2)

I: What kind of work do the scientist do?

S: ...it depends on what he invents. If he invents those bad things or cooperates with bad guys, then he is a bad scientist. (S1501-4)

3. Pupils regarded scientists' activities with viewpoints similar to those held by positivists--that is, to see scientific research as absolute truth, and experiments as playing the role of proof or verification.

I: Do they (scientists) know the result before they carry out the experiment?

S: They might have a hypothesis, then test the hypothesis by doing experiments. If you get an unexpected result, it means that your hypothesis is wrong.

I: Why does he make the hypothesis?

S: Because he has had the.....the experience from the last experiment, and he thought that if it is so in this case, then it ought to work in the same way in the other cases. (S2501-4)

The majority of pupils emphasized the importance of verification or test. In their opinions, verification is the key to the judge ment of whether a hypothesis is right or not, it is also the key to whether an invention is workable or not.

S: ...it (invention) also has to pass a TEST to prove it is workable and successful.

I: What kind of TEST?

S: Just as scientists, inventors should prove that their inventions are successful, and their notions are right. (S2604-5)

4. Pupils' images of the scientist were derived mainly from mass media, especially scientists' biographies.

Many researchers suggested that TV programs, children's ages, their social economical status, ect. would influence pupils' images of the scientist (Brush, 1979; Mead & Metraux, 1957; Head, 1985; Schibeci, 1986). However, in this study, many students reported that most of the messages about scientists which they remembered came from the scientists' biographies they read.

I: How do you know about scientists?

S: From books.

I: What kind of books?

S: Just like those which talk about the stories



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of scientists.

I: Did you mean scientists' biographies?

S: Yeah, I have a collection of such biographies. (S3603-3)

Moreover, based on their experiences and preconceptions, pupils tended to infer from the message received, forming therefore the images of scientists by themselves. As the traditional Chinese wisdom has it that intensive thinking makes one's hair turn gray(white), it is interesting to note the following excerpts.

I: How do you know they(scientists) look like that?

S: Well, sometimes I read from books, sometimes I imagine it by myself. Because the scientist always do experiment that are very crazy. When the experiment is not successful, it might cause explosion. That is the reason why some of them have such hair. In addition, they must keep thinking, so their hair easily turn gray. (S3504-5)

## Conclusions and implications

Although all the chlidren in this study have never met scientists, they could talk a lot about them, including their appearance, works, and personalities. However, they did not differentiate scientists from nonscientists very clearly. This result is similar to Rampal's study (1992) in India. In addition, it was noted that students paid much attention to scientists' contribution to the well-beings of mankind. While this may provide a noble motivation for some to become scientists, it also sets a high standard that many students feel they can not live up to. It also tends to enhance the notion that we should get all the resources

from nature and put them to hood use to make our life more convenient and comfortable. In addition to this, in spite of recent development in the philosophy of science, findings from this study indicated that pupils' images of science and scientists, still maintain close resemblance to the ideas of the positivists. It is note-worthy that mass media, such as scientists' biographies, play an important role in the formation of pupils' images of the scientists. This is certainly a useful hint for further investigations into the formation of pupils' image of the scientist, and for providing appropriate instructional support for elementary school children to construct less stereotyped images of the scientist.

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